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Biemiller

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[54] **ICE CUBE FORMING TRAY FOR ICE MAKING MACHINE**

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[51] **Int. Cl.**[3] **F25C 1/06**

[52] **U.S. Cl.** **62/347;** 62/523; 165/115; 249/81

[58] **Field of Search** 62/71, 73, 74, 347, 62/352, 515, 523, 348; 165/115, 116; 249/81, 132

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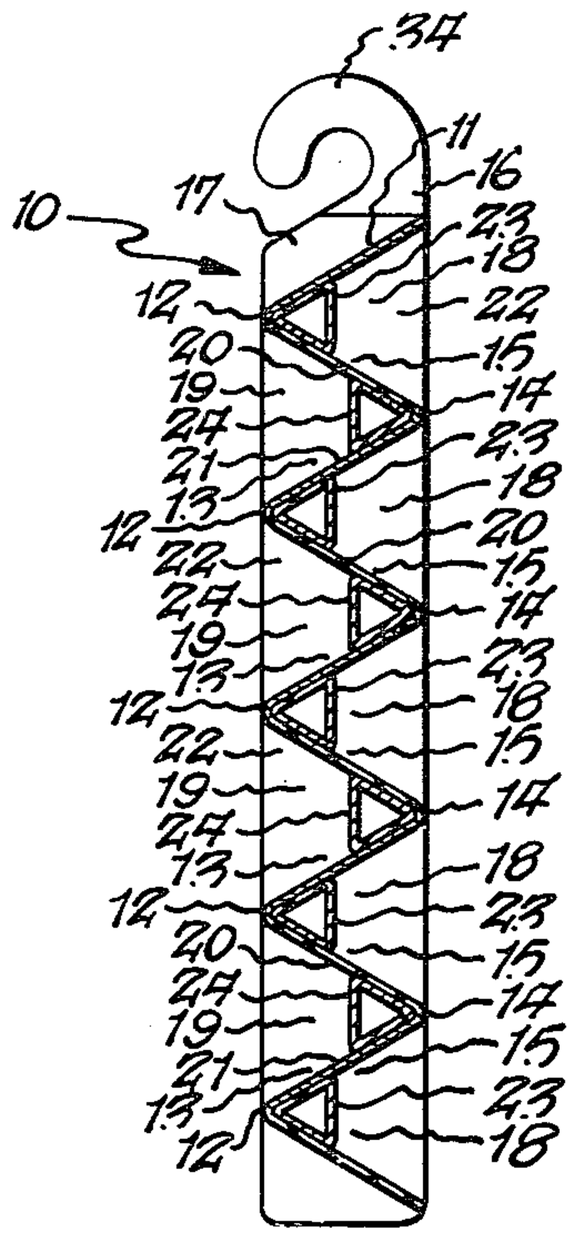
[57] **ABSTRACT**

An ice cube forming tray for an ice making machine consisting of a plurality of side-by-side corrugated plates having alternating ridges and grooves, straight plates separating the corrugated plates and also providing outer borders to the corrugated plates, and triangular evaporator coils located in complementary mating engagement in the apices of the ridges and passing through complementary mating openings in the plates. The plates which are not corrugated, instead of being straight, may be of hollow diamond-shape to also carry refrigerant.

20 Claims, 8 Drawing Figures



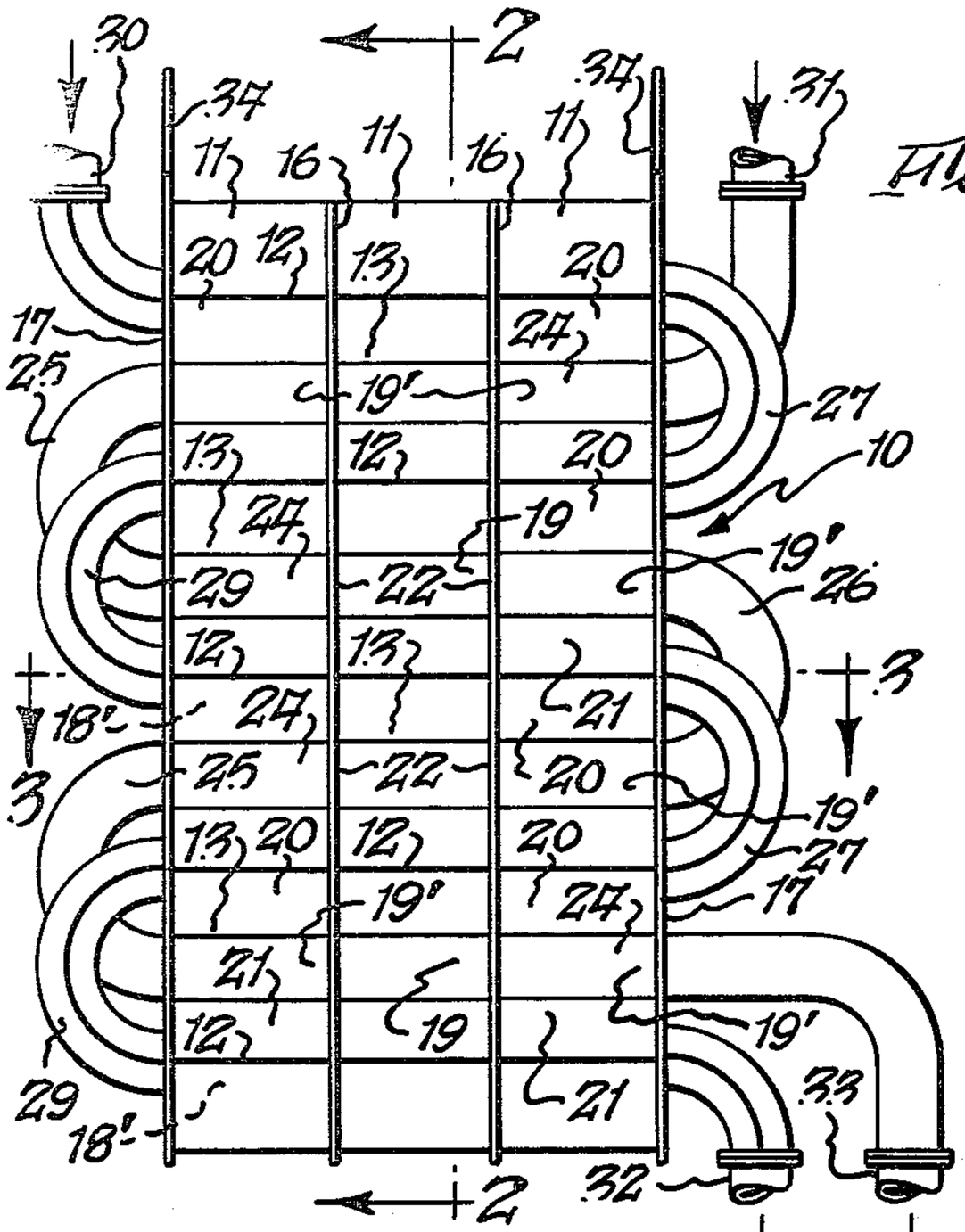


Fig. 1.

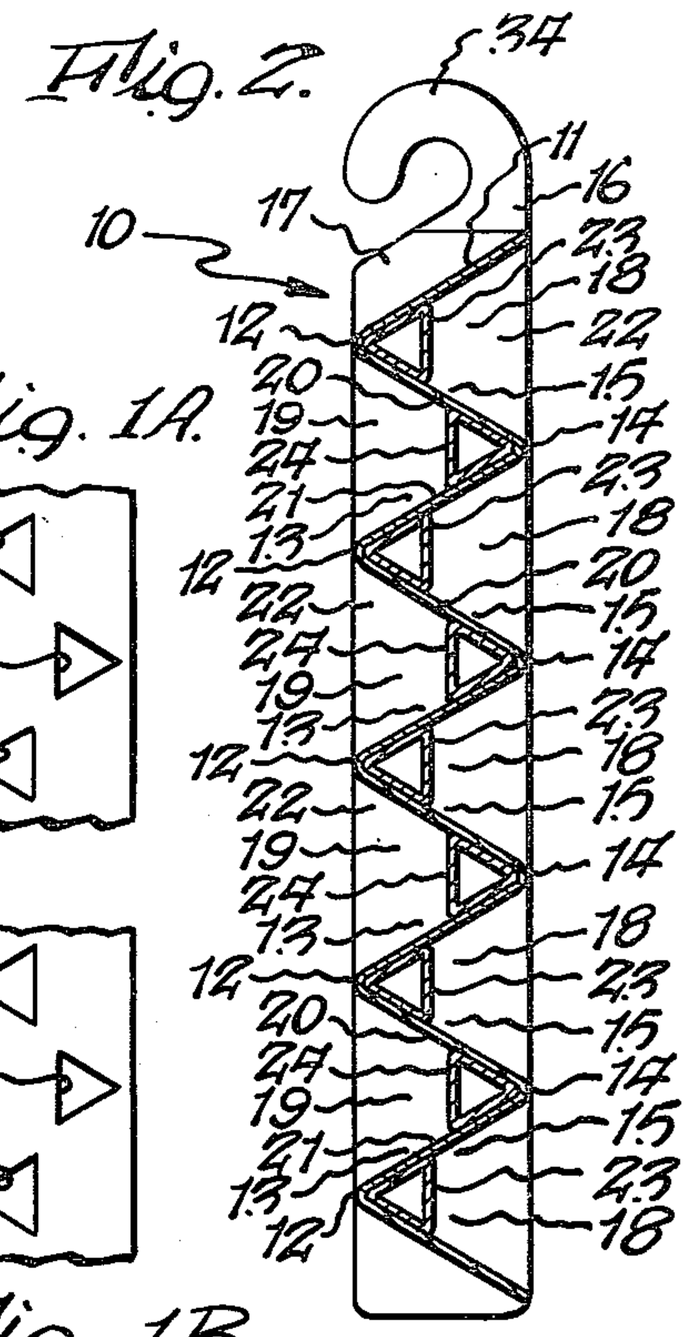


Fig. 2.

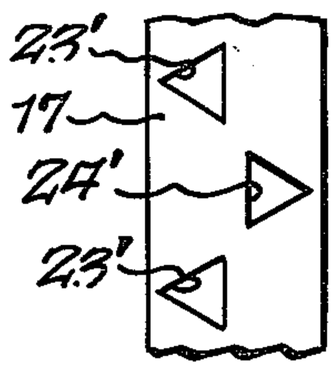


Fig. 1A.

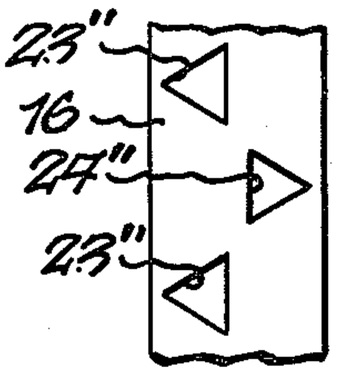


Fig. 1B.

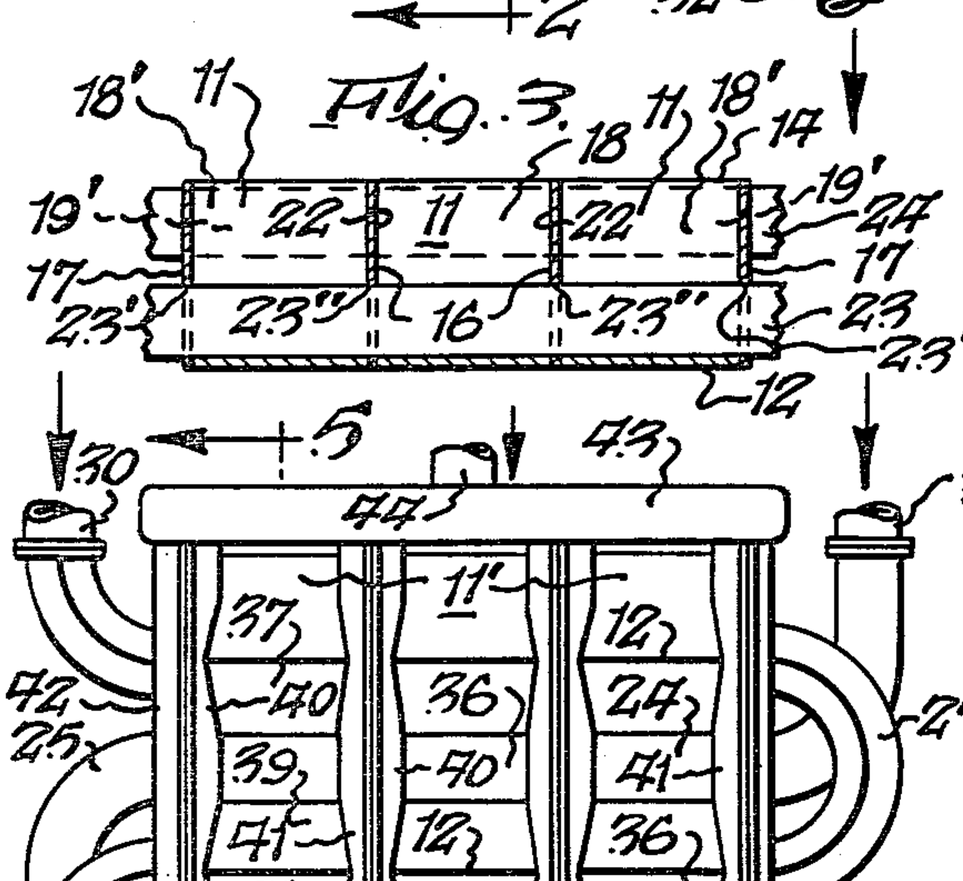


Fig. 3.

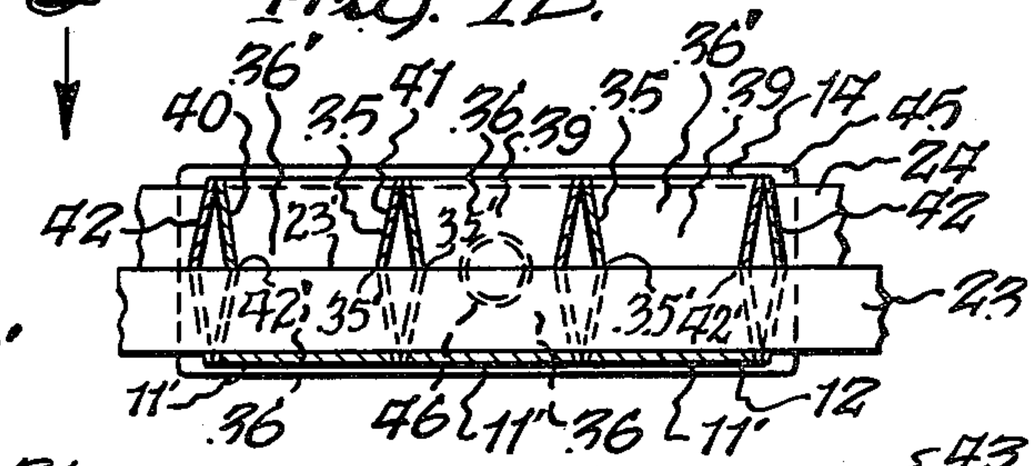


Fig. 6.

Fig. 4.

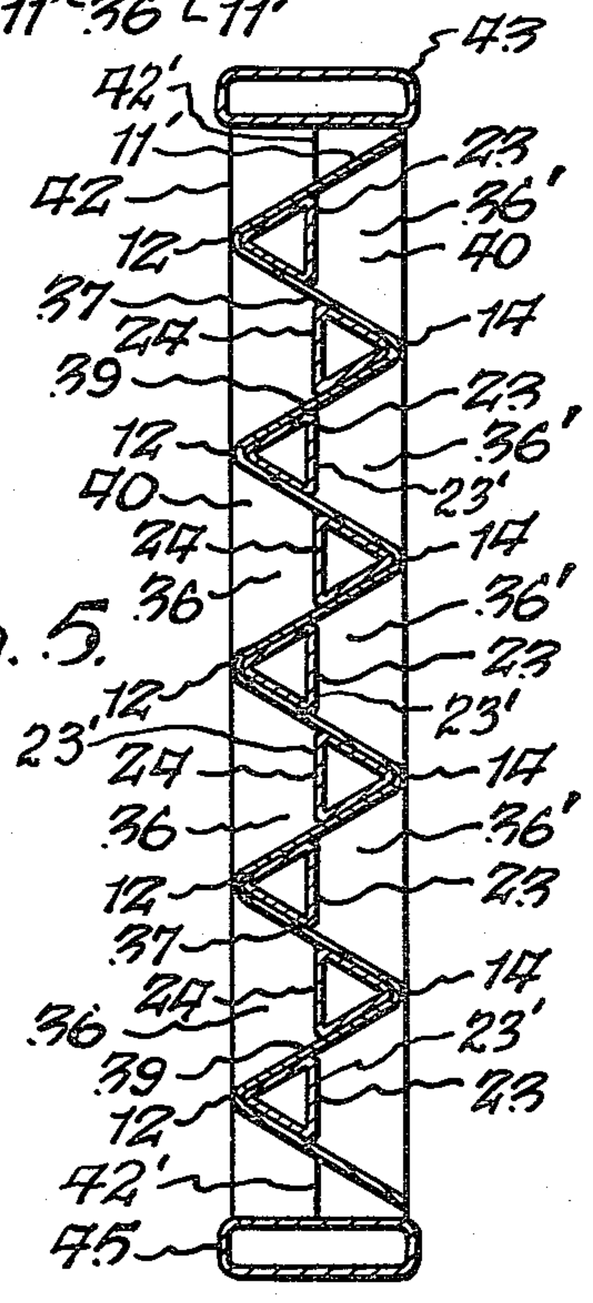


Fig. 5.

ICE CUBE FORMING TRAY FOR ICE MAKING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to an improved ice cube forming tray for an ice making machine.

By way of background, ice cube forming trays are known which have hollow walls surrounding the openings in which water is frozen, to thereby provide relatively efficient heat transfer. However, trays utilized in the past were relatively difficult to fabricate because of their complexity and thus they were relatively expensive. It is with overcoming this deficiency that the present invention is concerned.

SUMMARY OF THE INVENTION

It is accordingly one object of the present invention to provide an improved ice cube forming tray which not only forms ice cubes in openings which are in direct contact with refrigerant carrying conduits, but which is of a construction which permits it to be fabricated in a simple and inexpensive manner. Other objects and attendant advantages of the present invention will readily be perceived hereafter.

The present invention relates to an ice cube forming tray for an ice making machine comprising a plurality of members each formed to provide a plurality of aligned openings with alternating openings facing in opposite directions, first plate means located between adjacent members to provide first side walls, second plate means located at opposite outer sides of said plurality of members to provide second side walls, and a plurality of refrigerant-receiving evaporator tubes passing through said first and second plate means and being located in and forming the bottoms of said openings to provide direct engagement with water in said openings. Preferably the first and second plate means are hollow for receiving refrigerant and functioning as evaporator tubes to provide direct engagement with water in said openings. The present invention will be more fully understood when the following portions of the specification are read in conjunction with the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plan view of the improved tray of the present invention;

FIGS. **1A** and **1B** are fragmentary side elevational views of the planar plates which are associated with the corrugated plates to produce ice-forming openings in the tray;

FIG. **2** is a cross-sectional view taken substantially along line **2—2** of FIG. **1**;

FIG. **3** is a fragmentary cross sectional view taken substantially along line **3—3** of FIG. **1**;

FIG. **4** is a plan view similar to FIG. **1** but showing a modified form of the present invention in which the longitudinal dividers are hollow diamond-shaped tubes;

FIG. **5** is a cross sectional view taken substantially along line **5—5** of FIG. **4**; and

FIG. **6** is a fragmentary cross sectional view taken substantially along line **6—6** of FIG. **4**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The improved ice cube forming tray **10** includes a plurality of corrugated plates **11** which are formed into

alternating ridges and grooves **12** and **13**, respectively, on one side and alternating ridges and grooves **14** and **15**, respectively, on the opposite side. A plurality of first plates **16** are located between adjacent plates **11**. In addition, a plurality of second plates **17**, which are similar to plates **16**, are located on the outer sides of outermost plates **11**. Plates **11** in conjunction with the plates **16** and **17** provide a plurality of ice-cube forming openings on opposite sides of the tray **10**. In this respect, openings **19** are bounded by walls **20** and **21** of corrugated plate **11** and by wall portions **22** of plates **16**. The openings **18** between plates **11** and **16** and on the opposite side of plate **11** are formed by analogous structure. Openings which are analogous to openings **18** and **19** are also formed between outer plates **11** and plates **16** and **17**. These openings on one side of the tray are designated by the numeral **19'** and on the opposite side of the tray by numeral **18'**.

As can be seen from FIG. **2**, side walls **20** and **21** of corrugated plate **11** converge to form ridges **12** and **14**. Located within the converging portions of walls **20** and **21** at ridges **12** are triangular-shaped evaporator tubes **23** which nest in complementary mating relationship in the apices formed by these walls. Likewise, evaporator tubes **24** which are triangular in cross section nest in complementary mating relationship between walls **20** and **21** at the apices formed at ridges **14**. Triangular refrigerant-carrying tubes **23** and **24** pass through aligned triangular openings in each of plates **16** and **17**, with which they fit in complementary mating relationship. A portion of plate **17** is shown in FIG. **1A** to show the orientation of triangular openings **23'** and **24'**, and a portion of plate **16** is shown in FIG. **1B** with openings **23''** and **24''** which are aligned with openings **23'** and **24'**.

It will be appreciated that if plates **11** are corrugated in a configuration other than shown, the refrigerant-carrying conduits can be formed in cross sectional configurations other than triangular to provide the desired complementary mating relationship. For example, plates **11**, instead of having peaks **12** and **14**, may possibly be formed in the shape of a square-wave with sloping sides, in which event the tubes analogous to **23** and **24** would be trapezoidal in cross section and the openings in plates analogous to **16** and **17** would also be trapezoidal to accept the tubes in complementary mating relationship.

The portions of triangular tubes **24** outside of outer plates **17** are connected by return bends **25** on one side of the tray and by return bend **26** on the opposite side of the tray. Triangular refrigerant carrying evaporator tubes **23** are connected by return bends **27** on one side of the tray and by return bends **29** on the opposite side of the tray. The return bends may be attached to the straight portions of tubes **23** and **24** in any acceptable manner. Refrigerant is supplied to conduits **23** from inlet conduit **30** and is supplied to conduits **24** from inlet conduit **31**.

At this point it is to be noted that the tray **10** includes the evaporator coils **23** and **24** of a refrigeration system, as is well known in the art. This system includes a compressor, condenser, expansion valve and evaporator, all connected in series. As is well understood when the evaporation occurs in the evaporator, which is essentially tray **10**, freezing will be effected of the water which is splashed into openings on the opposite sides of tray **10** in any suitable manner. Conduits **30** and **31** are

connected to the expansion valve, and outlet conduits **32** and **33** are connected to the compressor, conduit **32** being in communication with lowermost refrigerant conduit **23** and conduit **33** being in communication with lowermost refrigerant conduit **24**.

By virtue of the fact that refrigerant carrying conduits **23** and **24** are in direct communication with the openings **18, 19, 18'** and **19'** in which ice cubes are formed, a highly efficient cooling of the water is obtained. In this respect, it is to be noted that the water is placed into these openings in any suitable manner, as by splashing, or by the use of suitable spray nozzles, or by directing a water stream downwardly on the ice cube forming tray **10** which is suspended vertically by means of hooks **34** formed at the upper ends of outer plates **17**.

After the ice cubes have been fully formed in the openings **18, 19, 18'** and **19'**, the refrigerant flow in the refrigerating system is reversed so that hot refrigerant flows directly to conduits **30** and **31** from the compressor, to thereby provide a defrost cycle which melts the part of the ice cubes adjacent the walls of the tray so that the ice cubes can be harvested. The freezing and defrost cycles can be adjusted by any suitable means, or suitable controls can be provided within the system, as is well known in the art, to effect harvesting at a predetermined part of the refrigerating cycle.

It will be appreciated that the tray **10** is relatively simple to fabricate in view of the fact that it is essentially constructed of aligned plates **16** and **17** which are oriented relative to corrugated plates **11** as shown in the drawings, with the refrigerant conduits **23** and **24** passing through openings **23', 24', 23''** and **24''**, and nesting in complementary mating relationship in the apices formed by the converging side walls.

In FIGS. **4–6** a modified form of the present invention is disclosed. In this embodiment, plates **11'**, which are analogous to plates **11** of FIGS. **1–3** and which form ridges **12** and **14**, have their outer edges of a configuration to fit in complementary mating relationship with the outer walls **42** at the outer edges of the tray and the vertical divider walls **35** between plates **11'**. Walls **35** and **42** are shown as being diamond-shaped in cross section (FIG. **6**). However, outer walls **42** only need to fit with plates **11'** in complementary mating relationship, and therefore they need not be diamond-shaped and their outer surfaces on the opposite sides of plates **11'** can be of any desired shape. The configuration of the outer edges of plates **11'** can be visualized from FIGS. **4** and **6**. The tops **23'** of evaporator tubes **23** are in line with peaks **35'** of divider walls **35** and peaks **42'** of walls **42**. Openings **36** in which ice cubes are formed are defined by sloping side walls **37, 39, 40** and **41**. Openings **36'** on the opposite side of the tray have analogous sloping side walls. The sloping side walls produce a draft on all four sides of each ice cube which is formed, and this enhances release of the cubes from the tray during the harvesting cycle. In addition, as can be visualized from FIGS. **4–6**, practically all sides of each ice cube which is being formed is in direct contact with a tube, such as **23, 24, 35**, and **42**, which carries refrigerant. In this respect, as can be seen, tubes **24** carry refrigerant as do tubes **23**. In addition, refrigerant is supplied to walls **35** and **42** from header **43** which is in communication with the expansion valve through conduit **44**. Walls **35** and **42** are also in communication with outlet header **45** which leads to conduit **46** which is in communication with the compressor. Therefore, since a large portion of the walls of each opening in which each ice cube is formed is in direct contact with an evaporator coil, highly efficient freezing of water is obtained, as well as highly efficient defrosting, because there is relatively little heat transfer through walls which do not comprise the evaporator coil.

Walls **35** and **42** have triangular openings therein which are analogous to openings **23', 24', 23''** and **24''** of FIGS. **1A** and **1B**. It is through such aligned openings in walls **35** and **42** that refrigerant tubes **23** and **23** pass. Furthermore, as in the embodiment of FIGS. **1–3**, return bends **25** and **26** connect tubes **24** and return bends **27** and **29** connect tubes **23**. Suitable sealant is provided at the joints where the tubes **23** and **24** pass through members **35** and **42**.

It can thus be seen that the improved ice cube forming tray of the present invention is manifestly capable of achieving the above-enumerated objects, and while preferred embodiments of the present invention have been disclosed, it will be appreciated that the present invention is not limited thereto but may be otherwise embodied within the scope of the following claims.

What is claimed is:

1. An ice cube forming tray for an ice making machine comprising a plurality of members each formed to provide a plurality of aligned openings with alternating openings facing in opposite directions, first plate means located between adjacent members to provide first side walls, second plate means located at opposite outer sides of said plurality of members to provide second side walls, and a plurality of refrigerant-receiving evaporator tubes passing through said first and second plate means and being located in and forming the bottoms of said openings to provide direct engagement with water in said openings.

2. An ice cube forming tray for an ice making machine as set forth in claim **1** wherein said first and second plate means are hollow for receiving refrigerant and functioning as evaporator tubes to provide direct engagement with water in said openings.

3. An ice cube forming tray for an ice making machine as set forth in claim **2** wherein said first and second plate means provide a draft to the sides of said openings.

4. An ice cube forming tray for an ice making machine as set forth in claim **3** wherein said openings are bounded by walls which produce a V-shaped form and wherein said evaporator tubes have diverging side walls for complementary mating engagement with the apices of said V-shaped forms.

5. An ice cube forming tray for an ice making machine as set forth in claim **4** wherein said evaporator tubes are triangular in cross section.

6. An ice cube forming tray for an ice making machine as set forth in claim **2** wherein said plurality of members are corrugated plates.

7. An ice cube forming tray for an ice making machine as set forth in claim **2** wherein said first plate means are of diamond shape in cross-section.

8. An ice cube forming tray for an ice making machine as set forth in claim **1** wherein said openings are bounded by walls which produce a V-shaped form and wherein said evaporator tubes have diverging side walls for complementary mating engagement with the apices of said V-shaped forms.

9. An ice cube forming tray for an ice making machine as set forth in claim **8** wherein said evaporator tubes are triangular in cross section.

10. An ice cube forming tray for an ice making machine as set forth in claim 1 wherein said plurality of members are corrugated plates for providing alternating ridges and grooves.

11. An ice cube forming tray for an ice making machine as set forth in claim 10 wherein said refrigerant-receiving evaporator tubes are located at the bottoms of said grooves.

12. An ice cube forming tray for an ice making machine comprising a member formed to provide a plurality of aligned openings with alternating openings facing in opposite directions, plate means located on opposite sides of said member to provide side walls, and a plurality of refrigerant-receiving evaporator tubes passing through said plate means and being located in and forming the bottoms of said openings to provide direct engagement with water in said openings.

13. An ice cube forming tray for an ice making machine as set forth in claim 12 wherein said plate means are hollow for receiving refrigerant and functioning as evaporator tubes to provide direct engagement with water in said openings.

14. An ice cube forming tray for an ice making machine as set forth in claim 13 wherein said plate means provide a draft to the sides of said openings.

15. An ice cube forming tray for an ice making machine as set forth in claim 14 wherein said openings are bounded by walls which produce a V-shaped form and wherein said evaporator tubes have diverging side walls for complementary mating engagement with the apices of said V-shaped forms.

16. An ice cube forming tray for an ice making machine as set forth in claim 13 wherein said members are corrugated plates.

17. An ice cube forming tray for an ice making machine as set forth in claim 13 wherein said first plate means are of diamond shape in cross-section.

18. An ice cube forming tray for an ice making machine as set forth in claim 12 wherein said openings are bounded by walls which produce a V-shaped form and wherein said evaporator tubes have diverging side walls for complementary mating engagement with the apices of said V-shaped forms.

19. An ice cube forming tray for an ice making machine as set forth in claim 12 wherein said member is a corrugated plate for providing alternating ridges and grooves.

20. An ice cube forming tray for an ice making machine as set forth in claim 19 wherein said refrigerant-receiving evaporator tubes are located at the bottoms of said grooves.

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